**Test and Monitor:**

**Trial 1:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Catapult Angle | Straight Distance Traveled | Right/Left Angle from Norm | Safety | Can Be Let Go From 4 Ft. |
| 15° | 6 ft. | 5 degrees to left | Yes | Yes |
| 30° | 27 ft | 10 degrees to left | Yes | Yes |
| 45° | 50 ft. | 15 degrees to left | Yes | Yes |
| 60° | 59 ft. | 0 degrees | Yes | Yes |
| 75° | 55 ft. | 15 degrees to right | Yes | Yes |
| 90° | 57 ft. | 10 degrees to right | Yes | Yes |

**Trial 2:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Catapult Angle | Straight Distance Traveled | Right/Left Angle from Norm | Safety | Can Be Let Go From 4 Ft. |
| 15° | 4 ft. | Straight up and down | Yes | Yes |
| 30° | 24 ft. | 0 degrees | Yes | Yes |
| 45° | 49 ft. | 5 degrees to left | Yes | Yes |
| 60° | 56 ft. | 0 degrees | Yes | Yes |
| 75° | 57 ft. | 0 degrees | Yes | Yes |
| 90° | 53 ft. | 5 degrees to left | Yes | Yes |

**Trial 3:**

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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Catapult Angle | Straight Distance Traveled | Right/Left Angle from Norm | Safety | Can Be Let Go From 4 Ft. |
| 15° | 5 ft. | Straight up and down | Yes | Yes |
| 30° | 26 ft. | 5 degrees to right | Yes | Yes |
| 45° | 48 ft. | 0 degrees | Yes | Yes |
| 60° | 57 ft. | 0 degrees | Yes | Yes |
| 75° | 54 ft. | 5 degrees to left | Yes | Yes |
| 90° | 56 ft. | 5 degrees to right | Yes | Yes |

**Trial 4:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Catapult Angle | Straight Distance Traveled | Right/Left Angle from Norm | Safety | Can Be Let Go From 4 Ft. |
| 15° | 2 ft. | Straight up and down | Yes | Yes |
| 30° | 24 ft. | 5 degrees to right | Yes | Yes |
| 45° | 51 ft. | 5 degrees to left | Yes | Yes |
| 60° | 58 ft. | 0 degrees | Yes | Yes |
| 75° | 56 ft. | 0 degrees | Yes | Yes |
| 90° | 55 ft. | 0 degrees | Yes | Yes |

**Trial 5:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Catapult Angle | Straight Distance Traveled | Right/Left Angle from Norm | Safety | Can Be Let Go From 4 Ft. |
| 15° | 6 ft. | Straight up and down | Yes | Yes |
| 30° | 25 ft. | 10 degrees to left | Yes | Yes |
| 45° | 50 ft. | 0 degrees | Yes | Yes |
| 60° | 56 ft. | 5 degrees to left | Yes | Yes |
| 75° | 55 ft. | 0 degrees | Yes | Yes |
| 90° | 54 ft. | 5 degrees to right | Yes | Yes |

**Ways to Correct/Modify Launch:**

|  |  |
| --- | --- |
| Catapult Angle | Ways to Correct/Modify Launch |
| 15° | Make base overall base bigger because there wasn’t enough space for the arm to be launched |
| 30° | Same as 15° |
| 45° | Make holes for PBC smaller because it kept moving |
| 60° | Same as 45° |
| 75° | Same as 45° |
| 90° | Same as 45° |

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*Plots:*

Red= 15°

Green= 30°

Blue= 45°

Pink= 60°

Brown= 75°

Yellow= 90°

50 ft.

20 ft.

30 ft.

40 ft.

10 ft.

60 ft.

Left

Right

Launch Point

Patterns:

Our team noticed the overall pattern of this catapult was going mostly to the left or straight. The degree at which the catapult was going left or right stayed in the range of 5-15 degrees. This displayed that the catapult showed some constant measurements, and was not totally off every time we changed the angle or did a different trial. Our team was surprised when the 60 degrees went the farthest and straightest, because all launches landed around 56-59 ft. Our team without doubt could say if we launched the 60 degrees again it would land in this distance. At first, our team thought that the 75 was going to go the farthest, but we turned out wrong. If we did this again we would predicted the ball landing around 50 ft. for both the 75 and 90 degree angle. Another pattern we noticed was the 15 degrees and 30 degrees did not pass the 30 ft. mark. At 15 degrees it was really off, which is not that surprising because had such a small angle. At 30 it was really close to 30 feet, with only a few feet off. If we launched it again we wouldn’t be surprised if it didn’t pass 30 ft. at both these angles. As you see there were many patterns, variations, and predictions our team noticed.

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**Refine:**

Some Design Changes We Made On Our Prototype:

* Wood Thickness

We had thin wood, so we had to change it. First we had wood which was only 1 ½ inches thick. Soon our group thought it over, and we realized if we continued to use this wood the catapult would not be stable. After realizing this problem, we thought about using reinforcement wood, but once again thinking this over, we still had a problem with the frame, and arm because reinforcement would only be applied to the base. The best option for our group was to buy new wood which was 4 inches thick. This would solve our problem easily.

* Way to measure Trajectory Angle

We had to change our way to measure trajectory angle because having a block taken off and on would be hard to do and would take up to much time. At first our group was going to change the trajectory angle by simply changing the block size of the stopping point. It was then our group came to the question, “how will we take it off and on?” We thought off some ideas, but all seem to lack reliability and the only option for us was to change the way we measured the trajectory angle. We ended up using an angled wood (from base to frame), with certain holes in certain areas, to get the exact angle. The rod would be slide into the holes stopping the catapult arm at a certain degree. To figure this out we used Pythagorean Theorem. This was one of the most difficult problems we had faced during the Catapult project.

* Center of Gravity

We had to add weights to our catapult because the center of gravity was not in the center. This problem was a type of problem that could not be edited. So we thought about it and ended up added weights to front of the catapult. This solved our problem of tipping over, but our group believes if we could do this project again we would definitely give more attention to the center of gravity.

* Way to Let Go of Catapult

At first we were going to use a gear that would have string tied around it. We realized if we did this the catapult would not launch properly and it would be hard to pull the string. We used a lock and key instead of this because it was easier to get off and it would launch the catapult properly.

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*Why Our Chart Came In Handy:*

After making this minor change to the wood thickness, we thought nothing could possibly go wrong, until we realized the way we measure our trajectory angle was not efficient. We looked backed to the chart and realized there were three options: redesign way to change angle, remove or add pieces to catapult, or edit the stopping point of the catapult. Looking at these three options the first one seem to be the most logical, easiest, and best to work. We didn’t choose remove or add pieces to catapult because in this case it really didn’t help the angle situation of the catapult. We also didn’t use the option of changing the stopping point of the catapult because that was the piece that was lacking efficiency.

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**Lessons Learned**

What Avani Learned:

“I learned that working in a group requires a lot of corporation and team work. When someone had difficulty finishing a task, then we would all work together and finish it. It also taught me was to be open to new ideas. Now I realize that everyone has their own thoughts and reasons, and it is only fair if you listen to them. I also got to experience new personalities, and characteristics that work differently then I do.”

What Kyle Learned:

“That group size is important to a group as its workers are. If you have 3 people working and 1 slacking that 1 person can mess everything up… this can change the group from getting an A or B to a C, D or maybe even an E.”

What Nicole Learned:

“I learned that the more people you have in the group, the easier it is to get tasks done. There are also fewer responsibilities for each group member because the work is separated evenly. I also learned that it is important to communicate with all of the group members in order to know what is going on, and what task each person is working on.”

What Brian Learned:

“I learned that some projects are easier just by the group members you work with. If you can work together, it will be a much better project.

What We Learned As a Group:

“We learned that working as a group can help us experience the real world when we grow up. Working together and as a team is a normal part of everyone’s job, and should be developed into one’s brain if they want to work effectively at their future task.”

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**Summary**

Overall Comments About Work Completed:

“It was an easier project because we are getting use to long projects, and working together.”

“This project has given us a chance to experience with different characteristics and personalities that we become fond of.”

“Building the catapult was the hardest part of the project.”

“It really gave us a chance to work together with new people.”

“The catapult was a really interesting project which helped us deal with everyday problems.”

Overall Summary:

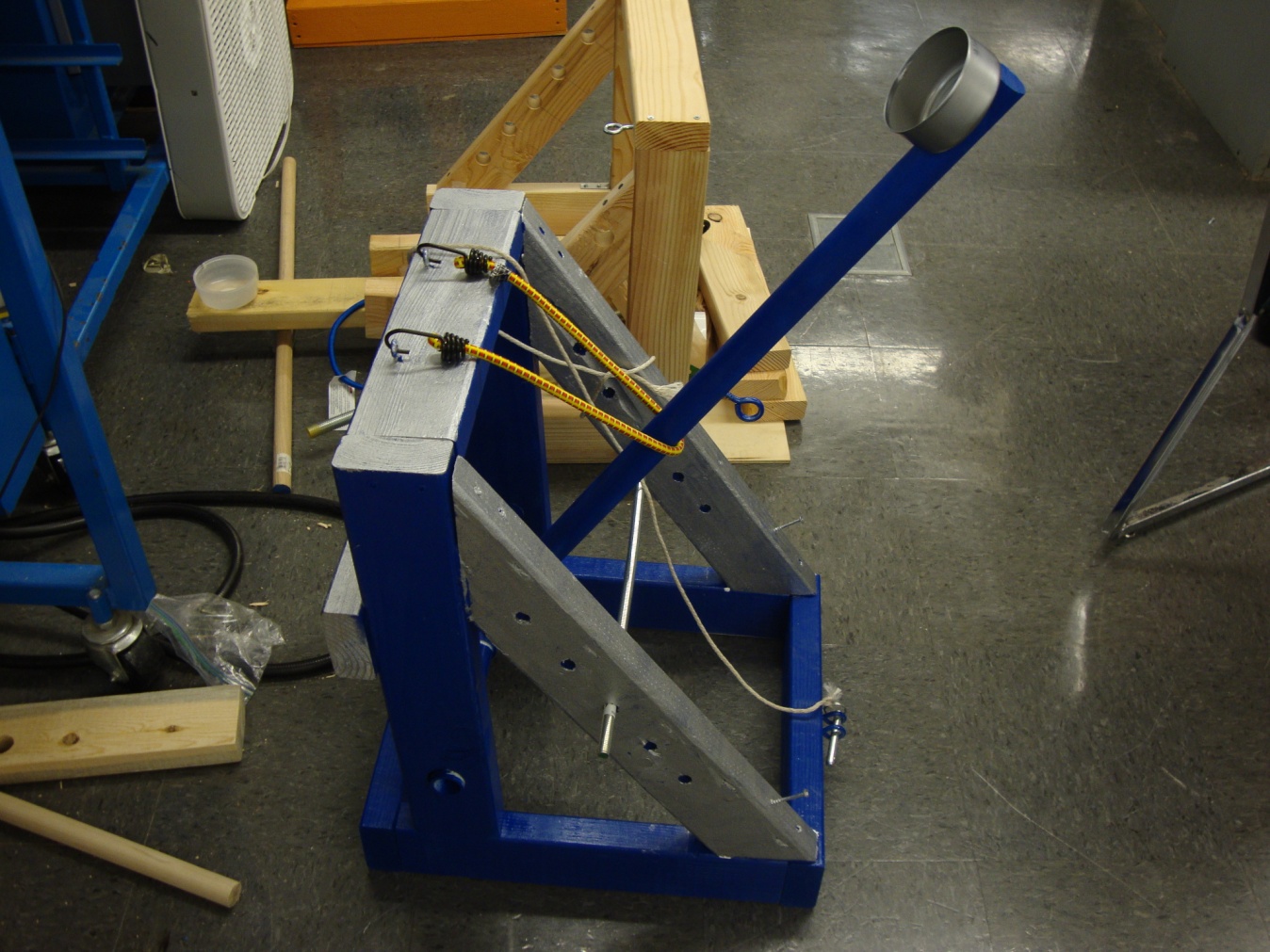
Are group thinks this project really gave us a chance to interact with new people, and trust those team members to finish the job they were told to do. We also think this project really got us ready for the world that is beyond the walls of Bartlett High School. Not only did it get us ready for college and further obstacles in life, but taught us some skills that we will never forget. Overall our group thinks this project was challenging but for the lessons, facts, skills, and tools it taught us, it was sure worth the challenge.

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*Attachments*

*(Pictures of our catapult)*

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